My NASA Data - Lesson Plans

Tropical Cyclone Counts - Compare Data Displays

Grade Band

- 6-8
- 9-12

Lesson Duration

- 50 minutes

Sphere(s)

- Atmosphere

Phenomena

- Hurricane Dynamics

NGSS Disciplinary Core Ideas

- ESS3B: Natural Hazards

Science and Engineering Practices

- Developing and Using Models
- Analyzing and Interpreting Data
- Using Mathematics and Computational Thinking

NGSS Crosscutting Concepts

- Scale, Proportion, and Quantity

Supported NGSS Performance Expectations

- MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
- HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
Supported Common Core Math

- CC.9-12.S.ID.1 Summarize, represent, and interpret data on a single count or measurement variable. Represent data with plots on the real number line (dot plots, histograms, and box plots).*
- CC.9-12.S.ID.2 Summarize, represent, and interpret data on a single count or measurement variable. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two
- CC.9-12.S.ID.6 Summarize, represent, and interpret data on two categorical and quantitative variables. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.*
- CC.6.SP.1 Develop understanding of statistical variability. Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. For example, “How old am I?” is not a statistical.
- CC.6.SP.2 Develop understanding of statistical variability. Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.
- CC.6.SP.3 Develop understanding of statistical variability. Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.
- CC.6.SP.5 Summarize and describe distributions. Summarize numerical data sets in relation to their context.
- CC.7.SP.3 Draw informal comparative inferences about two populations. Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multipl

Related Resources

- Tropical Cyclone Counts Graphing Bundle
- Compare Data Displays Create Graphs
- Tropical Cyclone Counts Model
- Tropical Cyclone Counts Histogram
- Tropical Cyclone Counts Create Histogram
- Tropical Cyclone Counts Box Plot
- Tropical Cyclone Counts Create Box Plot
- Tropical Cyclone Counts Scatter Plot
- Tropical Cyclone Counts Create Scatter Plot
- Tropical Cyclone Count Bar/Column Chart
- MATHEMATICS: Data Support Specialist
- MATHEMATICS: Data Scientist
- MATHEMATICS: Mathematical Modeler
- MATHEMATICS: Model Analyst
- Hurricane Sandy to Scale
- Will there be more tropical cyclones in the future?
- Data Literacy Cubes

Student Handout(s)

- Compare Data Displays Student Sheets
Teacher Resource(s)

- Compare Data Displays Lesson

Key Vocabulary

- histogram
- box plot
- scatter plot
- hurricane
- tropical cyclone
- Frayer Model
- latitude
- Longitude
- Graph Choice Chart

Purpose

The purpose of this lesson is for students to compare data displays to determine which best answers the driving question. To do this they will evaluate the spread of the data and what the displays show. They can create their own data displays or use the ones provided. This is part of the Tropical Cyclone Counts Graphing Bundle and can be completed independently or with the other activities in the bundle.

Learning Objectives

- Analyze how the phenomenon changes with location
- Identify patterns and relationships in data
- Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread of two or more different data sets.
- Represent data with plots on the real number line with a Histogram, Box Plot and Scatter Plot

NASA Phenomenon Connection

Hurricanes are large, swirling storms with winds of 119 kilometers per hour (74 mph) or higher. That's quicker than a cheetah can run which is the fastest animal on land.

Hurricanes are said to be the most violent storms on Earth. These storms are also called by other names, such as typhoons or cyclones, depending on where they occur. The scientific term for these storms is “tropical cyclone.” Only tropical cyclones that form over the Atlantic Ocean or eastern Pacific Ocean are called “hurricanes”. Whatever they are called, tropical cyclones all form the same way. (see https://pmm.nasa.gov/education/articles/how-do-hurricanes-form)

Because tropical cyclones are like giant engines that use warm, moist air as fuel, they form only over warm ocean waters near the equator. The number of hurricanes occurring each year varies widely from ocean to ocean, depending on how much warm ocean water exists. The most active area is the northwestern Pacific Ocean, which contains a wide expanse of warm ocean water. On average,
twenty six tropical cyclones form in this region each year, of which seventeen reach hurricane (typhoon) status. In contrast, the Atlantic Ocean averages about ten storms annually, of which six reach hurricane status. Compared to the Pacific Ocean, the Atlantic is a much smaller area, and therefore supports a smaller expanse of warm ocean water to fuel storms. The Pacific waters also tend to be warmer, and the layer of warm surface waters tends to be deeper than in the Atlantic. Overall, about 80 tropical cyclones occur annually across the globe, one-third of which achieve hurricane status. The frequency and intensity of hurricanes varies significantly from year to year, and scientists haven’t yet figured out all the reasons for the variability. (see https://earthobservatory.nasa.gov/Features/Hurricanes/hurricanes_3.php)

Tropical cyclones usually weaken when they hit land, because they are no longer being “fed” by the energy from the warm ocean waters. (see https://pmm.nasa.gov/education/articles/how-do-hurricanes-form)

**Essential Questions**

The driving question is the reason they will be investigating tropical cyclones and different types of data displays.

Which data display is most useful for determining the risk of a tropical cyclone in a given area and preparing an effective emergency plan?

**Cross-Curricular Connections**

This lessons involves students evaluating the spread of tropical cyclone count data from 1842 through 2017 to determine which type of data display provides the most useful information for determining risk for a location. Students will write their conclusions using the Claim-Evidence-Reasoning technique.

**STEM Career Connections**

- General Scientist - A scientist is a person that works in a specific field to acquire or uncover knowledge related to the natural world.
- Meteorologist – as defined by the American Meteorological Society - a person with “specialized education who uses scientific principles to explain, understand, observe, or forecast the earth's atmospheric phenomena and/or how the atmosphere affects the earth and life on the planet.”
- Reporters and Correspondents - Report and write stories for news outlets.

**Materials Required**

- Histograms, Box Plots and Scatter Plots (student produced or copies of the versions provided)
- Student question sheets
- Paper or index cards for exit tickets
Technology Requirements

- Internet Required

Background Information

Tropical Cyclones

1. Tropical cyclones are also called hurricanes or typhoons depending upon where they form.

2. Share background information from these options. Choose the best option for the class.
   - “What is a Hurricane?” [https://oceanservice.noaa.gov/facts/hurricane.html](https://oceanservice.noaa.gov/facts/hurricane.html)
   - “How does a Hurricane Form?” [https://scijinks.gov/hurricane/](https://scijinks.gov/hurricane/)

3. Inform students that some homeowners who live in high risk locations are required to purchase flood insurance. Homeowners can take steps to protect their homes from floods and high winds as well. It is also important to have a plan. Students can explore the following resources for more information.
   - FEMA Hurricane Information [https://www.ready.gov/hurricanes](https://www.ready.gov/hurricanes)

Prerequisites Student Knowledge

Students should be familiar with histograms, box plots and scatter plots.

Student Misconception

Students may not understand that data displays or graphs summarize information in various ways and that not all graphs are appropriate for analyzing data with a particular questions in mind.

Procedure

Assess Prior Knowledge of Data Displays

Group students to work on graphic models. Each group should have at least 3 students.

1. Each group should write the types of questions that each type of data display can answer in the corresponding boxes. The Graph Choice Chart can be used as a reference.
2. Optional: If students completed the Tropical Cyclone Counts Histogram, Tropical Cyclone Counts Box Plot or Tropical Cyclone Counts Scatter Plot mini lessons, they can use their exit tickets and write the questions on the Graphic Model. If not, do the next step.

3. Each group should also generate a question about tropical cyclones for each type of data display.

The Graph Choice Chart by The Maine Data Literacy Project*, based on a work at participatoryscience.org
Analyze data

1. Option 1: Create one or more of the required data displays as directed in the following lesson.
   - Compare Data Displays - Create Graphs
Re-group students from graphic model groups by data display, histogram, box plot, scatter plot.

Provide data to students and have them graph the type of plot assigned to their group.

Proceed to Analyze Plots

Extension: Use a software tool to make a scatter plot, histogram and/or box plot.

2. Option 2: Use data displays that are provided

Re-group students from graphic model groups by data display, histogram, box plot, scatter plot.

Give each group copies of the plots for the type assigned to them to use in analyzing the data.

3. Analyze Plots

Jigsaw – Each group has a different type of plot.

Each group should analyze their plot (not the raw data) to determine the information it provides regarding tropical cyclone counts at different latitudes for the longitudes used.

Have students look for information like minimum, maximum, median, mode, correlation, distribution, patterns in data. Each plot will not provide the same information.

Students go back to their original graphic Model Groups to discuss patterns by latitude for all plot types.

Students will share what they determined for their plot type with the group.

- What did the plot show?
- What patterns did you see?
- Does the plot answer any of the questions your group asked in their graphic model for that type of graph?

4. Students will discuss the map image and compare it with the other three plot types.

- Which type of graph is most useful for determining the latitudes with the highest and lowest tropical cyclone risk?
- What can you conclude about the distribution of tropical cyclones?
Number of Tropical Cyclones at 125 Degrees West between the Equator and 40 Degrees North
Number of Tropical Cyclones at 125 Degrees East between the Equator and 40 Degrees North

Number of Tropical Cyclones at 125 Degrees West between the Equator and 40 Degrees North
Number of Tropical Cyclones at 125 Degrees East between the Equator and 40 Degrees North

Number of Tropical Cyclones from the Equator to 40 Degrees North at 125 Degrees East
Number of Tropical Cyclones from the Equator to 40 Degrees North at 125 Degrees West
<table>
<thead>
<tr>
<th>Type of plot</th>
<th>Max</th>
<th>Min</th>
<th>Median</th>
<th>Mode</th>
<th>Correlation</th>
<th>Distribution</th>
<th>Patterns</th>
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</thead>
<tbody>
<tr>
<td>Histogram</td>
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<td>Box Plot</td>
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<td>Scatter Plot</td>
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</table>
Assessment

1. Revisit the driving question *Which data display is most useful for determining the risk of a tropical cyclone in a given area and preparing an effective emergency plan?*

2. Students will use the Claim-Evidence-Reasoning technique to answer the question.
**Claim:** (One sentence statement that addresses the driving question: WHICH DATA DISPLAY IS MOST USEFUL FOR DETERMINING THE RISK OF A TROPICAL CYCLONE IN A GIVEN AREA AND PREPARING AN EFFECTIVE EMERGENCY PLAN?)

<table>
<thead>
<tr>
<th>Evidence: Sufficient, Appropriate, and Observation Driven</th>
<th>Reasoning: (Why is this evidence important?)</th>
</tr>
</thead>
<tbody>
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<td>2.</td>
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<td>3.</td>
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<td>Histogram 1.</td>
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<td>3.</td>
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<tr>
<td>Box Plot 1.</td>
<td>Box Plot 1.</td>
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<td>2.</td>
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<td>3.</td>
<td>3.</td>
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<tr>
<td>Scatter Plot 1.</td>
<td>Scatter Plot 1.</td>
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<tr>
<td>2.</td>
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<tr>
<td>3.</td>
<td>3.</td>
</tr>
<tr>
<td>Description</td>
<td>3 Points</td>
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<td>-------------</td>
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<tr>
<td>Claim</td>
<td>Makes an accurate and complete statement linking the functions of the data displays to the conclusion.</td>
</tr>
<tr>
<td>Evidence</td>
<td>Provides sufficient evidence to support claim using qualitative and quantitative observations of the displays and their uses.</td>
</tr>
<tr>
<td>Reasoning</td>
<td>Provides reasoning that connects each piece of evidence to the claim. Uses data analysis skills to explain why the evidence supports the claim.</td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

Sources:

- [https://pmm.nasa.gov/education/articles/how-do-hurricanes-form](https://pmm.nasa.gov/education/articles/how-do-hurricanes-form)
- [https://pmm.nasa.gov/education/articles/how-do-hurricanes-form](https://pmm.nasa.gov/education/articles/how-do-hurricanes-form)
- [https://oceanservice.noaa.gov/facts/hurricane.html](https://oceanservice.noaa.gov/facts/hurricane.html)
- [https://www.nasa.gov/audience/forstudents/5-8/features/nasa-knows/what-are-hurricanes-58.html](https://www.nasa.gov/audience/forstudents/5-8/features/nasa-knows/what-are-hurricanes-58.html)
- [https://scijinks.gov/hurricane/](https://scijinks.gov/hurricane/)
- [https://www.ready.gov/hurricanes](https://www.ready.gov/hurricanes)

* The Graph Choice Chart by The Maine Data Literacy Project*, based on a work at participatoryscience.org
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